

Aerosol synthesis of porous SiO₂-Cobalt-catalyst for Fischer-Tropsch Synthesis (FTS)

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Porous particles with well-defined pore structures are of interest for applications involving catalyst due to their unique properties (Rytter et al., 2007). Recent studies (Saib et al., 2002) have shown that the selectivity for higher hydrocarbons in the Fischer-Tropsch synthesis (FTS) can be controlled by tuning the size of the mesopores of the catalyst support. For C₅₊ hydrocarbons, which can be used as gasoline, a pore size of 7 nm is favoured. Another requirement that needs to be taking into account is the cobalt particle size as the selectivity is related to both, the particle size and the support (Borg et al., 2008). Moreover, it was found a strong influence of the cobalt particle size on the cobalt turnover frequency (TOF) (Iglesia et al., 1997). Herein, for the production of an optimal catalyst particle is important to control the pore size and the cobalt particle size independently.

The aim of this contribution is to show a simple method to synthesis the desired porous SiO₂-Cobalt-catalyst particles where the cobalt particle size, the pore size and the cobalt loading can be tuneable independently.

For the particle synthesis a suspension of silica, a certain amount of PVP as a pore template and a suspension of prefabricated Co₃O₄ nanoparticles, is prepared and spray-dried. The produced agglomerates are calcinated to remove the remaining PVP leading to pore structures.

The particle size of the Co₃O₄ nanoparticles can be controlled by varying the amount of PVP added in the solvothermal process, as is described in (Xie et al., 2014). With increasing the amount of PVP the Co₃O₄ nanoparticles size decreases as it can be seen from Fig 1.

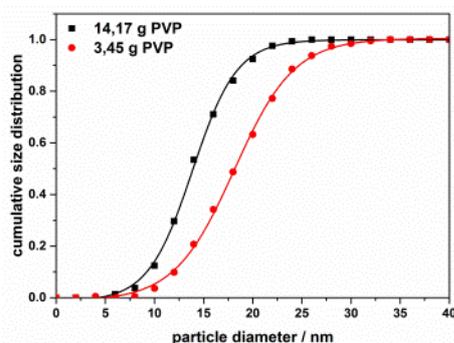


Figure 1. Cobalt particle size as a function of the different amount of PVP.

Regarding to the pore size, it is also possible to control it by adding different amount of PVP in the final suspension for the spray drying, as it is shown in Fig 2 an increase of PVP concentration results in an increase

of the pore size which agrees well with the results of (Zeng et al., 2014) where no Co₃O₄ nanoparticles were integrated inside the silica Building Blocks

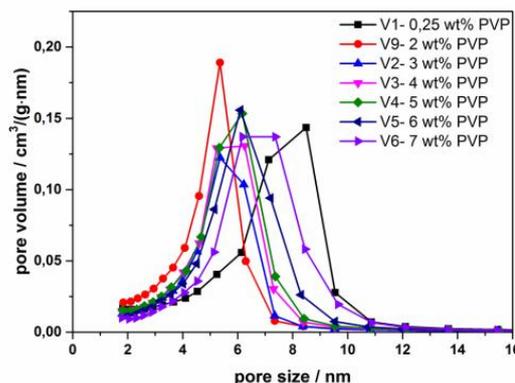


Figure 2. Pore size distribution as a function of the different amount of PVP

The advantage of this method is the formation of the support agglomerates and catalyst particles with the desired pore size and Co particle size in the same synthesis step and the independent control of support pore diameter and catalyst particle size. In fig 3 the catalyst particles before and after calcination are shown.

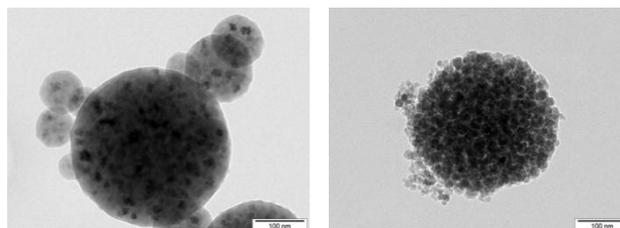


Figure 3. Catalyst particle before calcination (left) and after calcination (right)

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